

WE CLAIM:

1 1. A method of generating ultraviolet light,
2 comprising the steps of:
3 tuning a neodymium-doped yttrium aluminum garnet
4 crystal laser to output a first fundamental beam at
5 approximately 946 nanometers;
6 doubling the frequency of the first fundamental
7 beam to produce a second harmonic beam having a wavelength
8 of approximately 473 nanometers; and
9 producing a fourth harmonic beam having a
10 wavelength of approximately 236.5 nanometers by doubling the
11 frequency of the second harmonic beam using a first cesium
12 lithium borate crystal oriented for non-critical phase-
13 matching.

1 2. The method of claim 1, further comprising the
2 step of cooling the first cesium lithium borate crystal to
3 between -10 degrees centigrade and -20 degrees centigrade.

1 3. The method of claim 1, further comprising the
2 step of disposing the first cesium lithium borate crystal in
3 a container of dry inert gas.

1 4. The method of claim 1, further comprising the
2 step of disposing the first cesium lithium borate crystal in
3 a vacuum.

1 5. The method of claim 1, further comprising the
2 step of confocal focusing of the second harmonic beam into
3 the first cesium lithium borate crystal.

1 6. The method of claim 1, further comprising the
2 steps of:

3 tuning a rare earth doped garnet laser to emit a
4 second fundamental beam at a wavelength of approximately
5 1077 nanometers;

6 directing the second fundamental beam and the
7 fourth harmonic beam to a second cesium lithium borate
8 crystal; and

9 sum-frequency mixing the second fundamental beam
10 and the fourth harmonic beam in the second cesium lithium
11 borate crystal to produce an output beam at approximately
12 194 nanometers.

1 7. The method of claim 3, wherein the dry inert
2 gas is selected from the group consisting of nitrogen, dry
3 air, helium, neon, argon, krypton and xenon.

1 8. An apparatus for generating ultraviolet
2 light, comprising:

3 means for tuning a neodymium-doped yttrium
4 aluminum garnet crystal to output a first fundamental beam
5 at approximately 946 nanometers;

6 means for doubling the frequency of the
7 fundamental beam to produce a second harmonic beam having a
8 wavelength of approximately 473 nanometers; and

9 means for producing a fourth harmonic beam having
10 a wavelength of approximately 236.5 nanometers by doubling
11 the frequency of the second harmonic beam using a first
12 cesium lithium borate crystal oriented for non-critical
13 phase-matching.

1 9. The apparatus of claim 8, further comprising
2 means for cooling the first cesium lithium borate crystal to
3 between -10 degrees centigrade and -20 degrees centigrade.

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1 10. The apparatus of claim 8, further comprising
2 means for disposing the first cesium lithium borate crystal
3 in dry inert gas.

1 11. The apparatus of claim 8, further comprising
2 means for disposing the first cesium lithium borate crystal
3 in a vacuum.

1 12. The apparatus of claim 8, further comprising
2 means for confocal focusing of the second harmonic beam into
3 the first cesium lithium borate crystal.

1 13. The apparatus of claim 8, further comprising:
2 means for emitting a second fundamental beam at a
3 wavelength of approximately 1077 nanometers;
4 means for directing the second fundamental beam
5 and the fourth harmonic beam to a second cesium lithium
6 borate crystal; and
7 means for tuning the second cesium lithium borate
8 crystal to sum-frequency mix the second fundamental beam and
9 the fourth harmonic beam to produce an output beam at
10 approximately 194 nanometers.

1 14. The apparatus of claim 10, wherein the dry
2 inert gas is selected from the group consisting of nitrogen,
3 dry air, helium, neon, argon, krypton and xenon.

1 15. An apparatus for generating ultraviolet
2 light, comprising:
3 an active laser medium comprising a garnet crystal
4 doped with a rare earth element;
5 a diode pump laser for pumping the active laser
6 medium;

7 a resonator for generating a fundamental beam
8 having a wavelength of approximately 946 nanometers from the
9 pumped active laser medium;

10 a periodically-poled potassium titanyl phosphate
11 crystal for producing a second harmonic beam having a
12 wavelength of approximately 473 nanometers; and

13 a cesium lithium borate crystal cooled to a
14 temperature in the range from -10° centigrade to -20°
15 centigrade and oriented for non-critical phase-matching, for
16 producing a fourth harmonic beam having a wavelength of
17 approximately 237 nanometers.

1 16. The apparatus of claim 15, wherein the active
2 laser medium comprises a neodymium-doped yttrium aluminum
3 garnet crystal.

1 17. The apparatus of claim 16, wherein the
2 neodymium-doped yttrium aluminum garnet crystal comprises a
3 first un-doped end portion, a doped central portion and a
4 second un-doped end portion.

1 18. An apparatus for generating ultraviolet
2 light, comprising:

3 an Nd:LiYF₄ laser tuned to output a fifth harmonic
4 beam at approximately 209 nanometers;

5 a garnet laser doped with a rare earth element and
6 tuned to output a fundamental beam at approximately 1305
7 nanometers; and

8 a cesium lithium borate crystal for sum-frequency
9 mixing the fundamental beam and the fifth harmonic beam to
10 produce an output beam at approximately 180 nanometers.